



No.: 10/017,367

PRU-101US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No: 10/017,367
Applicant: Kevin K. Lehmann et al.
Filed: December 12, 2001
Title: FIBER OPTIC BASED CAVITY RING-DOWN SPECTROSCOPY APPARATUS
TC/A.U.: 2877
Examiner: Pham, Hoa Q.
Docket No.: PRU-101US

DECLARATION UNDER 37 C.F.R. §1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Peter B. Tarsa, hereby declare that:

1. I am currently employed by the Massachusetts Institute of Technology as a postdoctoral associate in the Biological Engineering Division. Previously, from 2001-2004, I was a doctoral candidate at Princeton University where, in that capacity, I was a co-inventor of various devices in the field of Cavity Ring-Down Spectroscopy.
2. Exhibit 1 is a copy of my *Curriculum Vitae* from which it can be seen that I have an honors degree in Chemistry, a Master's degree in Chemistry and a Ph.D. in Physical Chemistry.
3. I am a co-inventor of the invention which is the subject of this application.
4. I have reviewed the application and its prosecution history to date.
5. I understand that at present claims 1-8, 11-12, 14/11, 14/12, 17-49 and 52-56 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hensel et al. (DE-19814575A1) in view of Stewart (Intra-Cavity and Ring-Down Cavity Absorption with Fibre

Amplifier for Trace Gas Detection). I also understand that the remaining dependant claims stand rejected over various combinations of the Hensel and Stewart references.

6. In my opinion this combination of references does not result in our invention nor would one skilled in the art be lead to combine these references as suggest in the Office Action. My reasoning for this position is set forth in the following paragraphs.

7. On page 2, paragraph 3 of the Detailed Action, the examiner rejects claims in view of Hensel et al with reference to Figure 1 in German patent DE-19814575A1. The examiner claims that Hensel teaches of a "fiber optic ring (10)." I respectfully disagree; in fact, the Hensel reference shows a length of optical fiber drawn in the shape of a ring, but without joined ends. The resulting configuration does not form a closed loop and is effectively the same as a linear arrangement such as that for which we already argued the differences of in our affidavit filed in response to the last office action on November 16, 2004. In addition to this fundamental difference, which would prevent cavity ring-down operation of the fiber system, Hensel teaches a "optical transmitter (2)," not a "coherent source (2)" as set forth in the Office Action. This additional difference, which includes broadband light sources, makes the Hensel reference unsuitable for cavity ring-down spectroscopy.

8. On Page 3, the Office Action sets forth that it would be "obvious... at the time the invention was made to include in Hensel et al a plurality of couplers..." Assuming *arguendo* that this may be true, the addition of couplers to form a closed loop is not obvious because it creates a fundamentally different configuration from the Hensel arrangement.

9. "Regarding claim 2..." the examiner argues that measuring the rate of decay in the Hensel invention to determine trace species levels would have been obvious. This is not the case, however, because the device described by Hensel will not have a rate of decay. The absence of reflectors or a closed loop configuration prevents any resonance of the radiation, giving a negligible decay rate that has nothing to do with external species.

10. "Regarding claims 3 and 52..." the examiner argues that it would be obvious to replace two couplers with one. This is not obvious though because of problems with detector blinding. If a single coupler is used, a significant portion of the excitation radiation is directed

to the detector, causing saturation and limiting the measurement of very weak emission signals that decay soon after the excitation light is extinguished. While the cost benefits may, in hindsight, be obvious, the implementation of this configuration is not.

11. "Regarding claims 4-5..." it is not obvious to use an optical filter, as such devices are not normally used in cavity ring-down devices. Wavelength selection is conventionally accomplished with laser source tuning, eliminating the need for filters.

12. "Regarding claims 7-8, 17, and 55..." the examiner references Hensel figures 4 and 5. While these modifications may be commonly used to expose the transmitted light in an optical fiber for external sampling, it is not obvious that such techniques are compatible with a cavity ring-down system. Because a cavity ring-down resonator is very sensitive to the propagating mode, the use of these modifications in such a system does not carry obvious benefits. For instance, poorly made sampling regions will induce such high loss in a cavity ring-down system that will offset any sensitivity advantages afforded by this technique. Thus, their use in Hensel's figures does not obviously lead to their use in our invention. This may be concluded only by hindsight by using our disclosure as a template.

13. Regarding claims 11-12, 29-30, 19, and 20, the Office Action's position necessarily relies on the assumption that Hensel describes a passive loop configuration, when this is not at all the case. Thus, this position is unsupported with the references of record.

14. "Regarding claims 21 and 22..." Hensel does not teach of a single mode fiber in a loop configuration, as discussed above, and Stewart does not teach of a passive resonant fiber. In fact, Stewart teaches against a passive system, stating on page 2-16, "The ring-down time can be adjusted (and hence the sensitivity) by adjustment of the gain or of the variable attenuator (VA) in the loop." This affirms the fact that Stewart uses an active system. Again, we clearly set forth this significant difference in the Declaration filed on November .16, 2004.

15. "Regarding claim 31..." again assumes that Hensel teaches a closed loop, which he does not. In addition, the use of a cavity ring-down system for liquid measurements is not obvious, as the high loss intrinsic to a liquid medium may cause sufficient optical loss to reduce the ring-down signal beyond detectable levels. We have established experimentally that this is

not the case, but it was far from obvious. Again, it is apparent that our disclosure is being used as a template by which to reject our claims.

16. "Regarding claims 41-44..." it is not obvious that a means for controlling the radiation entering the ring is necessary. It is typical to simply abut a diode light source to a fiber end as a means for introducing high amounts of radiation. Instead, our invention provides a means for introducing a very low fixed percentage of the radiation into a closed loop configuration. Such a device is not only unnecessary in the Hensel device, it is opposite of this claimed embodiment.

17. "Regarding claims 45-47..." It is not obvious that a fire alarm requires a 15-20 meter length of fiber. Common fire alarm sensors are only a few inches long, as are discrete room air quality sensors. Thus it does not follow that a specific length would be required by Hensel's disclosure.

18. "Regarding claims 9-10..." (at page 5 of the Office Action) it is not obvious that an optical parametric generator (OPG) would work with the Hensel device. The high levels of optical power that are associated with an OPG would damage many types of fiber and associated components.

19. The other associations with the Lehmann patent (5,528,040) are not valid either, as the incorporation of optical fiber in a cavity ring-down arrangement changes many of the factors associated with system design and construction. Similarly, the incorporation of a second optical detector for triggering purposes is not completely straightforward due to detector saturation issues. For instance, the high amount of laser light that would fall upon a second detector would blind it, preventing accurate acquisition, while the analogous detector in Lehmann's patent receives only a small amount of light due to the optical layout. This difference makes the use of such a detector in a passive fiber optic arrangement far from obvious.

20. Based on the above distinctions and significant differences, in my opinion others skilled in the art would not be motivated to combine Hensel, Stewart or and Lehmann. Further,

even if the teaching away mentioned above was ignored and the combination made, that combination would not result in our claimed invention.

21. By my signature below, I hereby declare that all statements made in this document of my own knowledge are true, and that all statements made on information and belief are believed to be true. Further, I hereby declare that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing on the application.

Respectfully submitted,

Dated: May 24, 2005



Peter B. Tarsa

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EDUCATION

Princeton University	Princeton, NJ
Ph.D., Physical Chemistry, July 2004	
Thesis title: <i>Optical Fiber Cavity Ring-down Spectroscopy</i>	
Advisor: Kevin K. Lehmann	
M.A., Chemistry, May 2001	
Wake Forest University	Winston-Salem, NC
B.S. Chemistry, B.A. Physics, <i>cum laude</i> , May 1999	

AWARDS AND HONORS

- Coblentz Society Graduate Student Award, 2004
Society of Applied Spectroscopy, New York Section Graduate Student Award, 2004

RESEARCH EXPERIENCE

<i>Postdoctoral Associate</i>	2004-present
Biological Engineering Division, Massachusetts Institute of Technology, Cambridge, MA	
Advisor: Matthew J. Lang	
Investigated effects of mechanical force on protein function through spectroscopic methods, including optical tweezers and single molecule fluorescence. Developed assays for single molecule studies, including immobilization and tethering of oligonucleotides and proteins.	
<i>Graduate Research Assistant</i>	1999-2004
Department of Chemistry, Princeton University, Princeton, NJ	
Advisor: Kevin K. Lehmann	
Designed and improved new methods for Cavity Ring-down Spectroscopy, including optical fiber and prism-based resonators. Explored surface chemistry modifications to enhance spectroscopic detection of biological species. Authored NSF grant proposal to fund fiber-optic spectroscopy research, which initiated product development and steps toward commercialization at collaborating firm, Tiger Optics, LLC. Proposed inventions and guided legal counsel in preparation of project-related patents.	

<i>Technical Consultant</i>	2002-2004
Tiger Optics, LLC, Warrington, PA	
Collaborated with engineering and business teams for development and commercialization of research-related products. Advised Technical Review Board at annual meetings. Created research proposal for federal research funding of opto-electronic trace gas measurement device.	

Undergraduate Research Assistant 1997-1999

Wake Forest University, Winston-Salem, NC

Researched high vacuum methods for investigating polycyclic aromatic hydrocarbons with quasi-linear Shpol'skii spectroscopy in the ultraviolet and visible regions.

Summer Research Laboratory Assistant 1997-1998

Ocean Spray Cranberries, Inc., Lakeville-Middleboro, MA

Integrated chromatographic and spectroscopic methods for quantitative analysis of ingredients and products. Assisted in method development for both High Performance Liquid Chromatography and Capillary Electrophoresis.

TEACHING EXPERIENCE

Princeton University Princeton, NJ

Assistant in Instruction

Experimental Chemistry I, Fall 2001

Trained other teaching assistants, supervised and evaluated undergraduates, and prepared experiments for integrated laboratory course.

Experimental Chemistry II, Spring 2000

Taught and evaluated students in integrated laboratory course.

Advanced General Chemistry, Fall 1999

Created and led weekly classroom discussion of General Chemistry topics.

Wake Forest University Winston-Salem, NC

Teaching Assistant

General Physics, Fall 1997

Graded weekly problem sets.

ACADEMIC OUTREACH

Treasurer, Princeton University Scholars in the Schools 2002-2004

Coordinated outreach program in Trenton public schools through the development of a \$20,000 federal grant proposal and organization of 12 member graduate student team.

Class Representative, Princeton Chemistry Graduate Student Organization 2003-2004

Enhanced chemistry graduate student life through planning and organization of recruiting and social events.

PATENTS

Kevin K. Lehmann, Peter B. Tarsa, Paul Rabinowitz. "Fiber Optic Based Cavity Ring-Down Spectroscopy Apparatus," United States Patent Application # 20030107739, December 11, 2001.

Kevin K. Lehmann, Peter B. Tarsa, Paul Rabinowitz. "Method and Apparatus for Enhanced Evanescent Field Exposure in an Optical Fiber Resonator for Spectroscopic Detection and Measurement of Trace Species." United States Patent Application # 20030109055, May 29, 2002.

Kevin K. Lehmann, Peter B. Tarsa, Paul Rabinowitz. "Tapered Fiber Optic Strain Gauge Using Cavity Ring-down Spectroscopy." United States Patent Application # 20040118997, August 20, 2003.

PUBLICATIONS

John B. Dudek, Peter B. Tarsa, Armando Velasquez, Mark Wladyslawski, Paul Rabinowitz, Kevin K. Lehmann. "Trace moisture detection using continuous-wave cavity ring-down spectroscopy." *Analytical Chemistry*, 75 (17), 4599-4605, 2003.

Peter B. Tarsa, Paul Rabinowitz, Kevin K. Lehmann. "Evanescent field absorption in a passive optical fiber resonator using continuous-wave cavity ring-down spectroscopy." *Chemical Physics Letters*, 383 (3-4), 297-303, 2004.

Peter B. Tarsa, Diane M. Brzozowski, Paul Rabinowitz, Kevin K. Lehmann. "Cavity Ring-down Strain Gauge." *Optics Letters*, 29 (12), 1339-1341, 2004.

Peter B. Tarsa, Aislyn D. Wist, Paul Rabinowitz, Kevin K. Lehmann. "Single cell detection with cavity ring-down spectroscopy." *Applied Physics Letters*, 85 (19), 4523-4525, 2004.

PRESENTATIONS

Peter Tarsa, Paul Rabinowitz, Kevin Lehmann. "A Passive Optical Fiber Resonator for the Cavity Ringdown Detection and Measurement of Trace Species. Invited talk given at Tiger Optics, LLC. Technical Review Board Meeting, March 2002.

Peter Tarsa, Kevin Lehmann, Paul Rabinowitz. "A Passive Optical Fiber Resonator for Cavity Ringdown Spectroscopy." Talk given at International Symposium on Molecular Spectroscopy, Columbus, OH, June 2002.

P.B. Tarsa, P. Rabinowitz, K.K. Lehmann. "Passive optical fiber resonator for cavity ringdown spectroscopy." Poster presentation at 224th American Chemical Society National Meeting in both Analytical Chemistry and Sci-Mix sessions, Boston, MA, August 2002.

Peter Tarsa, Paul Rabinowitz, Kevin Lehmann. "A Passive Optical Fiber Resonator for the Cavity Ringdown Detection and Measurement of Trace Species." Poster presentation at SMART NJ Symposium on Biotechnology and Center for Photonics and Opto-Electronic Materials (POEM) Annual Research, Princeton, NJ, October 2002.

Peter Tarsa, Paul Rabinowitz, Kevin Lehmann. "Cavity ringdown spectroscopy in a passive optical fiber resonator." Poster presentation at Greater New York Metropolitan Area 2003 Chemistry Graduate Student Poster Session, New York, NY, February 2003.

Peter Tarsa, Paul Rabinowitz, Kevin Lehmann. "Expanded Applications: Optical Fiber Resonator." Invited talk given at Tiger Optics, LLC. Technical Review Board Meeting, May 2003.

P.B. Tarsa, P. Rabinowitz, K.K. Lehmann. "Optical Fiber Cavity Ring-down Spectroscopy" Poster presentation at 225th American Chemical Society National Meeting in both Physical Chemistry and Sci-Mix sessions, New York, NY, September 2003.

SKILLS

Scientific

Free space and fiber optics design and application in UV through mid-IR spectrum; laser installation, alignment, and maintenance; high vacuum techniques; chemical separation methods (HPLC, GC, and CE); spectral analysis techniques (UV/Vis, NIR, FT-IR, ¹H NMR, AA, Fluorescence spectroscopy); bacterial cell culture (*E. Coli*); mammalian cell biology techniques.

Interpersonal

Mentored two undergraduate and two graduate students in laboratory research and data analysis; personal tutor to high school chemistry and physics students.

Computer

Hardware: Computer design, construction, and laboratory interfacing; electronics design, repair and troubleshooting.

Software: MS Windows NT Server Administration, Mac OS administration, Blackboard Administration, MS Office, Adobe Photoshop, Jasc Paint Shop, Maple, Mathworks Matlab, Mathsoft Mathcad, Microcal Origin, Synergy Kaleidagraph

REFERENCES

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Dr. Paul Rabinowitz
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